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Issued May 16, 1913.

U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN 538.

SITES, SOILS, AND VARIETIES FOR CITRUS
GROVES IN THE GULF STATES.

BY

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WASHINGTON:
GOVERNMENT PRINTING OFFICE.

1913.



LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
OFFICE OF THE CHIEF,
Washington, D. C., March 27, 1913.

SIR: Many requests are received at the Department of Agriculture for information on the methods employed in growing oranges and other citrus fruits in Florida and the other Gulf States, and it is important that the department be able to supply the desired information as fully as possible. In order to furnish this information in concise form, Prof. P. H. Rolfs, Director of the Agricultural Experiment Station of Florida, has revised Farmers' Bulletin 238, entitled "Citrus Fruit Growing in the Gulf States," and has divided the material contained in that publication into three parts, of which this paper is the first, as follows: (1) "Sites, Soils, and Varieties for Citrus Groves in the Gulf States," (2) "Propagation of Citrus Trees in the Gulf States," and (3) "Culture, Fertilization, and Frost Protection of Citrus Groves in the Gulf States." In this form the information will be more available for distribution in the territory directly concerned and will be of more service, it is believed, to prospective fruit growers and to planters already engaged in this industry. I have the honor to recommend that the paper be published as a Farmers' Bulletin.

Respectfully,

WILLIAM A. TAYLOR,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

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SITES, SOILS, AND VARIETIES FOR CITRUS GROVES IN THE GULF STATES.

INTRODUCTION.

The following pages contain brief and concise directions for the choice of the proper sites, soils, and varieties for citrus orchards in the Gulf States, being a revision of one part of the material formerly published in Farmers' Bulletin 238. It has been the aim of the writer to furnish information to meet the needs of many inquirers rather than to prepare a complete treatise on the industry.

The growing of the finest citrus fruits is a horticultural accomplishment not surpassed in any line of the art. There are very few agricultural occupations that require an equal amount of judgment and very few that give as remunerative a return for the mental outlay. Everyone who is willing to pay the price, either in labor or in dollars, can grow oranges and grapefruit, but only he who is so constituted as to derive pleasure from exercising his mental faculties to their fullest extent can produce fruit of the finest quality. There is a very long series of conditions, from the choice of the site to the delivery of the package of perfect fruit to the consumer, which must be met successfully. If any link in the chain is broken, first place can not be attained. Good judgment must be exercised in the choice of the stock, the bud, the soil, and the location of the crop, in the treatment of fungous and insect diseases, in picking and packing the fruit, and in selecting a market for its disposal.¹

CLIMATE.

In general it may be stated that in all regions in which the temperature does not fall below 18° above zero nor rise above 100° F., under humid conditions, and where there is sufficient moisture, citrus fruits may be produced. However, there are localities within these limitations that can not be said to be good citrus-growing sections. In some

¹These subjects can not all be discussed here, however, and the reader is therefore referred to the following Farmers' Bulletins: No. 539, entitled, "Propagation of citrus trees in the Gulf States;" No. 542, entitled, "Culture, fertilization, and frost protection of citrus groves in the Gulf States;" and No. 172, entitled, "Scale insects and mites on citrus trees."

places, although the trees grow luxuriantly, heavy rainfalls occur at the time when the fruits are maturing, making it impossible to gather and market them. In others the conditions for vegetative growth are so favorable that very little fruit sets. Regions that are excessively dry may, however, be utilized for citrus culture when irrigation can be practiced. The more nearly the northern limit of the citrus belt is approached, the more sprightly and deliciously flavored the fruit becomes, some of the very best fruit being marketed from areas where the trees are every winter in danger of being frozen.

The ideal humid climate for citrus growing is one in which the rainfall occurs after the fruit has been shipped and before the new crop begins to ripen. The rainfall should not be excessive, certainly not more than 50 to 70 inches annually, and the winter temperature should not go below 26° to 27° F. of continued cold, though a lower temperature may be withstood for an hour or more without killing the trees. Orange trees in a thoroughly dormant condition can withstand a temperature as low as 24° F., if this is not continued for more than a few hours at a time. A very sharp turn to 18° F., even if for only a few hours, will entirely defoliate trees in the most dormant condition, while it is likely to kill the larger proportion of those in active growth. Small trees under 8 to 10 feet high, with poorly protected trunks, are very liable to be killed to the ground under these conditions. Sometimes snow falls and remains on the trees for several hours without seriously damaging orange trees, but this is of rare occurrence.

SOIL.

It will be shown under the heading "Varieties" that citrus trees are exceedingly variable, and consequently will readily adapt themselves to almost any kind of soil in which plants can grow. Varieties of citrus grow upon the sticky, adobe soils of Mesopotamia, upon the alluvial soils of the lower Mississippi, upon the fertile soils of the West India Islands, upon the dry soils of Arizona and California, and upon the almost sterile, sandy soils of Florida. There is probably no other genus of fruit trees in which the species are so plastic as to adapt themselves to almost every possible gradation of soil. It should not be inferred, however, that every variety of the genus can be grown upon all of these different kinds of soil, for it is absolutely necessary to choose the particular variety which is adapted to any peculiar soil.

While the rich, alluvial soils produce citrus trees of rank growth which often bear enormous crops of fruit, the finest and highest priced fruits are produced upon the nearly sterile soils. In fertile soils the plant food is seldom properly balanced or present in the condition best suited for producing the finest fruits, nor is it possible to influence the contents or quality of the fruit by applying different

forms of chemical fertilizers. If, therefore, a field is normally sufficiently fertile to produce a citrus crop for an indefinite number of years, it is usually impossible to influence the quality of fruit markedly by means of fertilizers. Upon soils which are nearly sterile, however, trees may be started and fed with just such chemicals as will produce the finest quality of fruit. It therefore happens that soils which formerly were considered absolutely worthless for agricultural purposes are now made to produce large crops of most excellent fruit.

SITE OF THE GROVE.

Immediately upon deciding to plant a grove the best site that can be procured should be selected. A great many questions arise in determining where a grove shall be located. A few of these are discussed below.

DISTANCE FROM TRANSPORTATION LINES.

Since the profit accruing from a grove is the grower's ultimate object, it becomes necessary to study the possibility of getting the fruit into the market cheaply. Long hauls by wagon over rough roads should be avoided wherever possible. Hauling by wagon is expensive and, what is more important, it consumes much time at a period when it is difficult to employ efficient labor.

The distance to which it is profitable to haul fruit will vary greatly. Hard-surfaced, smooth roads are found in nearly every progressive community. In some localities automobile trucks are employed for taking fruit from the grove to the central packing house, making the transfer charges low. The fruit is also less likely to be injured in transit. Under such circumstances a distance of 10 miles might be regarded as the maximum at which to start a grove. Under more adverse conditions one should not attempt to put out a grove at a greater distance from transportation facilities than 5 miles.

First-class citrus land can be purchased in nearly every favorable locality in Florida at prices ranging from \$20 to \$50 an acre. When located adjacent to hard-surfaced roads the price will vary from \$40 to \$100 or more an acre. Placing the average crop at 200 boxes per acre and the average cost of transferring the fruit from distant groves at 5 cents a box, the hauling charges would constitute a tax of \$10 per year per acre against such property. This charge would be for the hauling of the fruit alone, and would not include the handicap in securing labor, hauling supplies, and fertilizers.

CHARACTER OF THE SOIL.

The variation of the soils in the West Indies and in Louisiana and Mississippi is not so sharply marked as that in Florida. There are, however, characteristic soils in each of these regions that are better

than others. In all sections a soil must be chosen that is not underlain with a heavy substratum known as hardpan. The land should be elevated sufficiently to permit free drainage and in the sections where irrigation must be practiced should be so located that water can be easily supplied.

In Florida the soil usually known as hammock land is preferable for orange growing. This, however, is of limited extent and frequently is so far removed from transportation lines that it is not profitable to use it. The second grade is called piny woods land. Groves properly located on this type of soil and managed by intelligent superintendents frequently give the best returns. It is upon this land that most of the orange groves are located. The cabbage palmetto hammock, if sufficiently high to permit natural drainage, also makes excellent land for citrus growing.

DRAINAGE.

In Florida the question of drainage is of paramount importance. There is scarcely a large citrus grove in the State in which some section is not injured from time to time for the want of thorough and deep drainage. While the total annual rainfall is likely to vary within rather narrow limits, its distribution throughout the year will probably be exceedingly variable. The drainage system should be so constructed as to provide for periods of excessive rainfall rather than for the average of what might be expected. In choosing the site of a grove, one should ascertain that it is possible to dispose of the surplus water promptly. Groves have been situated near a lake or other body of water or on some site where it was impossible to dispose of the surplus water during a rainy period, and irreparable damage has resulted, although at the time of the excessive rainfall no injury was apparent. As a general rule, the water table for Florida should not rise higher than within 18 inches of the surface of the soil. Other conditions being the same, the groves in which it is 10 feet or more to the water table suffer less during a severe drought than those where the water table rises almost to the surface. A fluctuating water table is more objectionable than a constant one, however, even when the latter occurs high in the soil.

Water standing in a grove for a few days is almost certain to prove fatal, while water flowing through the grove for the same length of time will only injure it. It takes years to grow a good grove, which may be destroyed or ruined in a week.

The important points in drainage, then, are to be certain (1) that there is no possibility of ever having standing water in the grove, and (2) that the water table is as deep as possible in the soil; the farther down the better.

NATURAL FROST PROTECTION.

After determining that the desirable features specified are to be found in the location under consideration, it is very important to see that the land is well protected from the occasional frosts which visit the citrus-growing sections.¹ Frost protection is imparted by large bodies of water, such as make possible citrus growing in Louisiana, in Mississippi, and in Florida near the lakes in the central part of the State, along the Indian River on the east coast, and on Tampa Bay. In the West Indies and the southernmost part of Florida this factor does not enter into consideration. In fact, it seems that those places in the West Indies which are subjected to the lowest winter temperature produce citrus fruits of the highest excellence. The temperature in the vicinity of Mandeville, Jamaica, is said to go as low as into the fifties during winter nights, and yet this is probably the best citrus fruit section on the island.

PROTECTION FROM HIGH WINDS.

A location chosen so as to combine all the qualifications already mentioned may still be undesirable if it is exposed to the force of high winds, which may occur in any portion of the country. It is quite impossible to protect a grove against tropical hurricanes, but the more common high winds of frequent occurrence must be considered. They carry off the moisture and bring with them a dry, parching air which is injurious to citrus trees, and they are also very likely to cause "thorning" or to mutilate the fruit in other ways. Sometimes it becomes necessary to erect artificial windbreaks for protecting a grove not well located. These artificial windbreaks may later be supplanted by some natural growth that can withstand the force of the wind.

RAINFALL.

The amount of rainfall needed to produce a crop of citrus fruits depends on various factors; prominent among them are character of soil and humidity of atmosphere. Where there is a deficiency of moisture it may be supplied by irrigation, but a superabundance of moisture can be controlled only in a measure by drainage. In the humid portions of the United States and in the rainy sections of the West Indies heavy rainfalls frequently occur at the time when the fruit should be marketed or when the trees should be dormant preparatory to blooming. As these conditions can not be corrected, citrus orchards should not be planted in regions where excessive fall or winter rains are prevalent. This is especially true of the rainy side of most islands in the West Indies group.

¹ For a discussion of artificial frost protection, see Farmer's Bulletin 542, entitled "Culture, fertilization, and frost protection of citrus groves in the Gulf States."

VARIETIES.

The group of plants which is designated by the generic term "citrus" is fairly well circumscribed, but when it comes to a segregation of the different species and varieties scientists do not all agree. While it may be of interest to the scientific plant breeder to know just what the classification is, to the practical grower of fruits who wishes to get a large return for his labor it makes very little difference whether the product belongs to one variety or another. The results of the various attempts to classify the plants which fall under the general term "citrus" vary exceedingly, and differing opinions regarding their scientific relations are held by scientific investigators. There are therefore a number of different classifications. In Table I the writer has adopted the classification worked out by Dr. Herbert J. Webber in the *Cyclopedia of American Horticulture*.

TABLE I.—*Botanical and horticultural classes of the genus Citrus.*

Botanical species.	Botanical varieties.	Horticultural races.	Horticultural varieties.
I. <i>Trifoliata</i>			Trifoliatas. { Sour. Bittersweet. Seville.
	<i>amara</i>		
II. <i>Aurantium</i>	<i>bergamia</i>		Bergamot orange. { Bahia. Valencia.
	<i>sinensis</i>	The common oranges.....	Homosassa. Pineapple. (Also other varieties.) Satsuma. China (mandarin). Dancy (tangerine). Oneco. King. Royal.
III. <i>Nobilis</i>		The mandarin group.....	Pernambuco. Triumph. (Also other varieties.) Paradise. Forbidden Fruit. (Also other varieties.) Nagami. Marumi. (Also other varieties.) Corsican. Lyman. Orange. (Also other varieties.) Lisbon. Villa Franca.
IV. <i>Decumana</i>		Pomelo (grapefruit).....	
		Shaddock.....	
V. <i>Japonica</i>		Kumquats.....	
	<i>genuina</i>	Citron.....	
VI. <i>Medica</i>	<i>lemon</i>	Lemon.....	Sicily. Eureka. (Also other varieties.) Imperial. Mexican. Persian. (Also other varieties.)
	<i>acida</i>	Lime.....	

Experience has taught that no variety of citrus is preeminently useful for all portions of the world where this fruit is grown. As an illustration we have the Bahia, or Washington Navel orange, which is preeminently adapted for California, but is of little value in Florida

or the West Indies, where it produces only a small crop. Certain varieties of pomelo have an exquisite flavor when fruited in Florida, but are not of the same excellence when grown in California. The Pineapple orange and the Indian River orange are among the finest of fruits when grown in the sections where they originated, but when produced in Jamaica they can not be said to have superior qualities.

It becomes necessary, therefore, to test the particular variety in the section into which it is to be introduced. Some varieties are excellent in places far removed from one another, as is illustrated by the Satsuma, or Oonshiu, an introduction from Japan, and the Bahia orange, which was brought from Brazil by the United States Department of Agriculture and is now so extensively grown in California. The last-named variety produces fruit of excellent quality when grown in Florida, but, as stated, is not prolific. Frequently the most important varieties of citrus for any given locality are those which have originated as seedlings in that section, or have arisen as bud varieties. An illustration of a variety arising as a bud variation is the Surprise navel, originating in Mr. E. S. Hubbard's grove at Federal Point, Fla., from buds received from California. Seedlings, as a rule, "sport" or are exceedingly variable; they, however, come true to seed within certain limitations. So far as known, a pomelo can not originate from an orange seed, except where an orange flower is pollinated from a pomelo, and it is then not a true pomelo. Seedlings from the mandarin group reproduce a typical mandarin fruit. Seedlings from the sweet orange produce a typical sweet orange. Seedlings from pomelos produce pomelos of varying qualities.

The total number of varieties of citrus fruits that have been catalogued and described would run up into the thousands. Nearly every one has some peculiar merit for a particular locality. Out of the many thousands a few selected ones are of general value, and can be planted with safety over a considerable area. The following very brief list gives some of the varieties for the localities mentioned:

Florida.—The Florida State Horticultural Society has divided the State into four horticultural sections, known as western north Florida, eastern north Florida, central Florida, and south Florida.

Western north Florida includes that portion of the State lying west of the Aucilla River.

The main reliance in the citrus crop for that region should be in the Satsuma orange. Under special conditions this variety produces a most palatable and otherwise excellent fruit. Near the Gulf of Mexico, in frost-protected places, sweet seedlings, the Pineapple, Parson Brown, and other early-ripening varieties are planted in small orchards and are doing well.

Eastern north Florida includes "that part of the State between the Aucilla River and a straight line drawn across the State from the mouth of the St. Johns River to Cedar Keys."

The following citrus fruits are considered especially adapted for this region: Of the sweet-orange group, the Pineapple, Parson Brown, and Sweet Seville; of the tangerine group, the Satsuma; of the kumquat group, the Marumi and Nagami.

Central Florida includes "that part of the State between the line above referred to and the counties constituting south Florida."

Of the sweet-orange group well adapted to this section may be mentioned the Pineapple, Centennial, Tardiff, Homosassa, Jaffa, Majorca, and Parson Brown; of the mandarin group, the Satsuma, China, Dancy, and King; of the pomelo group, the Standard, Duncan, Excelsior, Hall, Marsh, and Royal.

Shaddocks and citrons are not grown as commercial fruits, and Nagami is the leading variety of kumquat for this section.

South Florida includes the following counties: Brevard, St. Lucie, Palm Beach, Lee, Dade, Monroe, De Soto, and Manatee.

The sweet oranges recommended for this section are the Hart, Valencia Late, Homosassa, and Majorca; of the mandarin group, the China, Dancy, and King; of the pomelo group, the Standard, Duncan, Excelsior, Hall, Marsh, and Pernambuco.

Shaddocks are not grown commercially and are found only as ornamentals or novelties. In the kumquat group the leading variety is the Nagami. Citrons are grown only as occasional specimens, and lemons are not grown extensively in Florida.

On the keys and the adjacent coast considerable quantities of limes grow without cultivation and are apparently naturalized. The United States Department of Agriculture has distributed various importations of limes in south Florida, and nearly all of these varieties do very well. The peculiar demands of the market, however, are such as to make extensive lime growing unprofitable. Nevertheless, very high prices are paid for the limes which are gathered from trees occurring spontaneously on the coast and keys. This lime is generally spoken of as the Key lime. It is a very small fruit and intensely acid and usually contains many seeds. This same lime when taken to the mainland and put under cultivation produces a large fruit with very thick, rough skin, approaching the lemon in size and appearance. Limes of this size do not meet with ready sale.

Louisiana and Mississippi.—The citrus-growing section of Louisiana and Mississippi closely borders the Gulf. In Mississippi it is near Biloxi, and in Louisiana it is south of New Orleans.

In these sections the common sweet orange grown is known as the Creole. This, strictly speaking, is not a variety, but an assemblage

of seedling oranges that have been cultivated in this region for some time. Of the mandarin group the Satsuma and China are the leading varieties. Of the pomelo group only a few are grown, these being the earliest varieties, such as the Standard, Royal, and Triumph.

Texas.—Considerable activity in planting citrus fruits in the Gulf region of Texas has occurred in recent years. The main reliance has been placed in the Satsuma on *Citrus trifoliata* stock.

Porto Rico and the West Indies generally.—Citrus growing throughout the West Indies is in a rather formative state. The efforts at systematic work in this line have not been carried forward with the same degree of vigor as in California and Florida. Nearly all the varieties recommended for south Florida may be planted with more or less confidence in this region. After years of experimenting local varieties will doubtless develop which will prove better than many of those now cultivated on these islands.